Claims

1. A node for use in a WDM optical network, the node comprising:

- a tributary receiver unit for receiving a data signal distributed via the WDM optical network and destined for said node,

- a path protection switching unit for switching receipt of said data signal at the tributary receiver unit from a working path to a protection path of the WDM optical network, and

- a control unit for the path protection unit,

wherein the control unit comprises a multi rate clock data recovery (CDR) device arranged, in use, to detect a loss of lock (LOL) in the data signal received at the tributary receiver unit based on a comparison of an actual data rate received and a pre-programmed reference rate for said data signal.

2. A node as claimed in claim 1, wherein the CDR device is further arranged, in use, to detect a loss of signal (LOS) in the data signal received at the tributary receiver unit.

3. A node as claimed in claim 2, wherein the CDR device comprises a 1R optical receiver element and a 2R binary detection element for detecting the LOS.

4. A node as claimed in any one of claims 1 to 3, wherein the control unit further comprises a signal quality detector unit for monitoring the quality of the data signal received at the tributary receiver unit.

5. A node as claimed in claim 1, wherein the path protection switching unit comprises an optical switch, and the control unit and the tributary receiver unit are located at the output side of the optical switch.

6. A node as claimed in claim 1, wherein:

- the path protection switching unit comprises an electrical switch,

- the control unit comprises at least two CDR devices and associated signal quality detectors, all located on the input side of the electrical switch, and

- the tributary receiver unit is located on the output side of the electrical switch and arranged as an electrical receiver,

and a pair of one CDR device and one associated signal quality detector is connected, in use, to the working path, and

another pair of one CDR device and one associated signal quality detector to the protection path.

7. A node as claimed in claim 1, wherein the node further comprises:

- one or more first network interface units arranged, in use, to demultiplex an incoming WDM optical signal and to convert the incoming WDM optical signal into a plurality of electrical channel signals,

- a plurality of 3R regeneration units for regenerating the electrical channel signals, and

- one or more second network interface units arranged, in use, to convert and multiplex at least one of the electrical channel signals into an outgoing WDM optical signal.

8. A node as claimed in claim 7, wherein each 3R regeneration unit is arranged, in use, to detect a LOL in its associated electrical channel signal and to force its output to a substantially static state in response to detecting the LOL.

9. A node as claimed in claim 8, wherein the 3R regeneration unit is advantageously further arranged to detect a LOS in its associated electrical channel signal, and to force its output to a substantially static state in response to detecting the LOS.

10. A node as claimed in claims 8 or 9, wherein each 3R regeneration unit is further arranged, in use, to create a laser disable output signal in response to detecting the LOL or LOS, and to transmit the laser disable output to a transmitter laser of the second network interface unit, wherein the transmitter laser is arranged, in use, to switch its laser output to a 3rd, non-binary state in response to the laser disable signal.

11. A node as claimed in claim 10, wherein each 3R regeneration unit is arranged, in use, to detect the 3rd, non binary state in its associated electrical channel signal received from another node, and to maintain its electrical output at the last received binary state when detecting the 3rd, non-binary state.

12. A node as claimed in claim 10, wherein each 3R regeneration unit comprises a 2R regeneration component arranged, in use, such that a gap exists between a threshold-low

binary detection state and a threshold-high binary detection state, and the 3rd, non-binary state is chosen, in use, such that it falls within said gap.

13. A node for use in a WDM optical network, the node comprising:

- one or more first network interface units arranged, in use, to demultiplex an incoming WDM optical signal and to convert the incoming WDM optical signal into a plurality of electrical channel signals,

- a plurality of 3R regeneration units for regenerating the electrical channel signals,

- one or more second network interface units arranged, in use, to convert and multiplex at least one of the electrical channel signals into an outgoing WDM optical signal, and

wherein each 3R regeneration unit is arranged, in use, to detect a LOL in its associated electrical channel signal and to force its output to a substantially static state in response to detecting the LOL.

14. A node as claimed in claim 13, wherein each 3R regeneration unit is further arranged to detect a LOS in its associated electrical channel signal, and to force its output to a substantially static state in response to detecting the LOS.

15. A node as claimed in claims 13 or 14, wherein each 3R regeneration unit is further be arranged, in use, to create a laser disable output signal in response to detecting the LOL or LOS, and to transmit the laser disable output to a transmitter laser of one of the second network interface units, wherein the transmitter laser is arranged, in use, to switch its laser output to a 3rd, non-binary state in response to the laser disable signal.

16. A node as claimed in claim 15, wherein each 3R regeneration unit is preferably arranged, in use, to detect the 3rd, non binary state in its associated electrical channel signal received from another node, and to maintain its electrical output at the last received binary state when detecting the 3rd, non-binary state.

17. A node as claimed in claim 16, wherein each 3R regeneration unit comprises a 2R regeneration component arranged, in use, such that a gap exists between a threshold-low binary detection state and a threshold-high binary detection state, and the 3rd, non-binary state is chosen, in use, such that it falls within said gap.

18. A method of conducting path protection in a WDM optical network, the method comprising the steps of:

- receiving a data signal at a tributary receiver unit of a network node,

- detecting a loss of lock (LOL) in the data signal received at the tributary receiver unit based on a comparison of an actual data rate received and a reference rate for said data signal, and

- switching receipt of said data signal at the tributary receiver unit from a working path to a protection path of the WDM optical network.

19. A method as claimed in claim 18, wherein the step of detecting the LOL comprises utilising a multi rate clock data recovery (CDR) device.

20. A method as claimed in claims 18 or 19, wherein the method further comprises the step of detecting a loss of signal (LOS) in the data signal received at the tributary receiver unit.

21. A method as claimed in claim 10, wherein the step of detecting the LOS comprises utilising the CDR device for detecting the LOS.

22. A method as claimed in claim 18, wherein the method further comprises monitoring the quality of the data signal received at the tributary receiver unit.

23. A method as claimed in claim 18, wherein the step of switching to the protection path comprises utilising an optical switch, wherein the tributary receiver unit is arranged as an optical receiver and is located at the output side of the optical switch.

24. A method as claimed in claim 18, wherein the step of switching to the protection path comprises utilising an electrical switch, and the method comprises the steps of:

- detecting LOLs and/or LOSs and monitoring the quality of the data signals on both the working and the protection path before the electrical switch, and

wherein the tributary receiver is located on the output side of the electrical switch and is arranged as an electrical receiver.

25. A method as claimed in claim 18, wherein the method further comprises the steps of, at the network node,:

- demultiplexing an incoming WDM optical signal and

- converting the incoming WDM optical signal into a plurality of electrical channel signals,

- regenerating the electrical channel signals utilising 3R regeneration, and

- converting and multiplexing at least one of the electrical channel signals into an outgoing WDM optical signal.

26. A method as claimed in claim 25, wherein the step of regenerating the electrical channel signals comprises detecting LOLs in the individual electrical channel signals and to force an output of the 3R regeneration for individual channels to a substantially static state in response to detecting the LOL.

27. A method as claimed in claim 26, wherein the step of regenerating the electrical channel signals further comprises detecting a LOS in the individual electrical channel signals, and to force its output to a substantially static state in response to detecting the LOS.

28. A method as claimed in claims 26 or 27, wherein the method further comprises the steps of:

- creating a laser disable output signal in response to detecting the LOL or LOS, and

- switching the output of a transmitter laser of the second network interface unit associated with one of the channel signals to a 3rd, non-binary state in response to the laser disable signal.

29. A method as claimed in claim 28, wherein the method comprises the steps of:

- detecting the 3rd, non binary state in the electrical channel signals received and converted form another node, and

- maintaining an electrical output of the 3R regeneration at the last received binary state when detecting the 3rd, non-binary state.

30. A method as claimed in claim 29, wherein the 3rd, non-binary state is chosen, in use, such that it falls within a gap between a threshold-low binary detection state and a threshold-high binary detection state in the 3R regeneration.

31. A method of conducting fault notification in a WDM optical network from one network node to another, the method comprising the steps of, at said one network node,:

- demultiplexing an incoming WDM optical signal and

- converting the incoming WDM optical signal into a plurality of electrical channel signals,

- regenerating the electrical channel signals utilising 3R regeneration, and

- converting and multiplexing at least one of the electrical channel signals into an outgoing WDM optical signal, and

wherein the step of 3R regenerating the electrical channel signals comprises detecting LOLs in the individual electrical channel signals and forcing the output of the 3R regeneration for individual electrical channels to a substantially static state in response to detecting the LOL.

32. A method as claimed in claim 31, wherein the step of regenerating the electrical channel signals further comprises detecting a LOS in the individual electrical channel signals.

33. A method as claimed in claims 31 or 32, wherein the method further comprises the steps of:

- creating a laser disable output signal in response to detecting the LOL or LOS, and

- switching the output of a transmitter laser of the second network interface unit associated with one of the channel signals to a 3rd, non-binary state in response to the laser disable signal.

34. A method as claimed in claim 33, wherein the method comprises the steps of:

- detecting the 3rd, non binary state in the electrical channel signals received and converted from another node, and

- maintaining an electrical output of the 3R regeneration at the last received binary state when detecting the 3rd, non-binary state.

35. A method as claimed in claim 34, wherein the 3rd, non-binary state is chosen, in use, such that it falls within a gap between a threshold-low binary detection state and a threshold-high binary detection state in the 3R regeneration.

36. A WDM network comprising a node as claimed in claims 1 or 13.

37. A WDM network arranged, in use, to implement a method as claimed in claims 18 or 31.